THE DUFAYCOLOR BOOK

DUFAY-CHROMEX LIMITED
MAKERS OF DUFAYCOLOR
14-16 COCKSPUR STREET, LONDON, W.1

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BOOK

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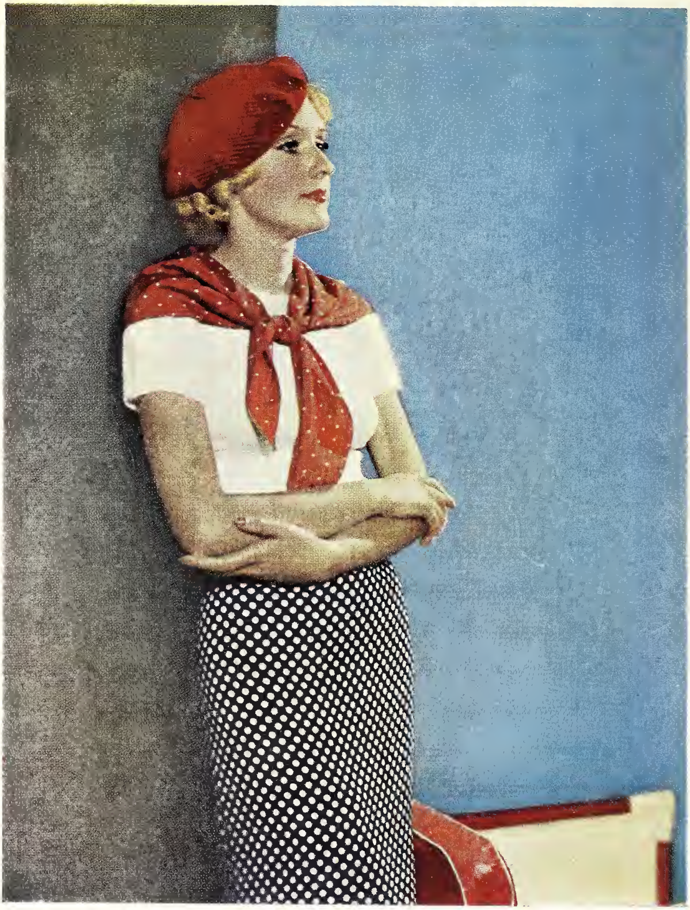


By courtesy of Tunbridge.

Reflected light from half-watt lamps totalling 2,500 watts and two 500 watt spots. Exposure 3 seconds at F/4.5 on Dufaycolor Flat Film through D2/2 filter.

Blocks by John Swain & Son, Ltd., Screen negatives made direct on to Ilford Rapid Process Panchromatic Plates through Ilford Tricolour Filters. 150 line screen.

The Dufaycolor Process

SECTION I

INTRODUCTION

Colour photography is by no means a new invention, but its use has been greatly restricted, partly on the ground of expense, but primarily because of the necessity for long exposures and somewhat difficult manipulation.

The new Dufaycolor process, which is remarkably easy to manipulate, has undoubtedly provided a stimulus to colour photography which will lead it to its rightful place in the photographic world.

Whenever it is desired to record an event or reproduce a scene or person in colour, the correct starting point is a photograph in colour, and now with the Dufaycolor process this can be produced with ordinary apparatus and with very little more skill than is required to make a black and white photograph. From this colour photograph further reproductions can be made in a variety of ways.

What it is and how it works

The Dufaycolor process gives transparencies on a flexible non-inflammable film and reproduces subjects in their full brilliance of colour. The transparency is viewed by holding it in front of any convenient diffused light source or by projection in a suitable apparatus.

The film consists of a transparent *non-inflammable* base on which is printed a very fine transparent colour pattern consisting of alternating blue and green squares and red lines. This pattern is called the "réseau" and in this the complete colour pattern (of three colours) is reproduced twenty times per millimetre (500 times per inch) for some types of material, and 23 times per millimetre (600 times per inch) for other types of material. Its extreme fineness, will, therefore, be readily appreciated.

The method of preparation of the réseau is a matter of much interest and also of very considerable practical difficulty;

the main steps in the process are shown in the illustration on the colour plate opposite, and the following is a brief outline of the procedure:—

The base is first coated with a very thin layer of collodion dyed blue; afterwards a set of greasy ink lines is printed at an angle to the length of the roll, there being twenty lines to the millimetre and the spaces between being equal in width to the lines. The method of printing is comparable with that of letterpress printing and it will be appreciated that the machinery required to produce such a result is a triumph of engineering enterprise and skill.

In the next operation the dye between the ink lines is bleached and the second dye bath results in the clear spaces being coloured green. The ink lines are now removed and a second set printed at right angles to the first. The lines this time are broader than in the first instance and the spaces between are narrower so that there are the same number of lines per millimetre as before.

The second bleaching bath now removes the green and blue dyes where there is no protective cover of ink. In the final bath these clear spaces are dyed red, and lastly the ink lines are removed. The reason for making the red lines narrower is to equalise approximately the areas of red, blue and green.

On top of the réseau to protect it, there is a very thin layer of varnish and then a coating of a special very highly sensitive panchromatic emulsion (see Fig. 1).

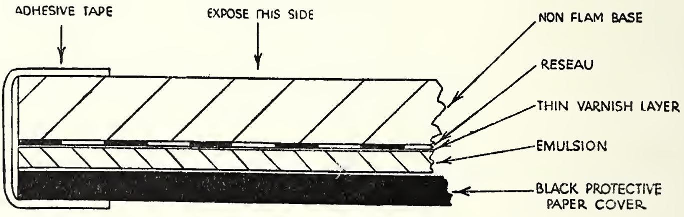
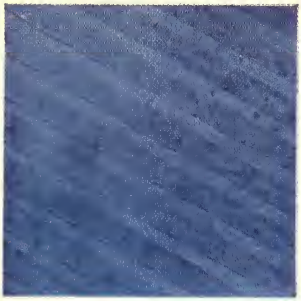


FIG 1 CROSS SECTION THROUGH PIECE OF DUFAYCOLOR FILM

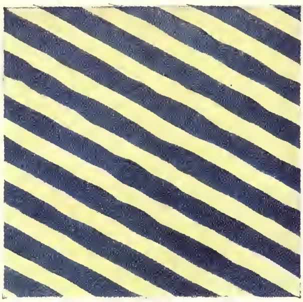
The film is exposed through the base so that the light passes through the colour réseau before reaching the emulsion.

PHOTOMICROGRAPHS OF DUFAYCOLOR RESEAU.

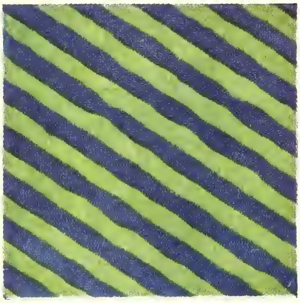
Magnification X100 Linear.



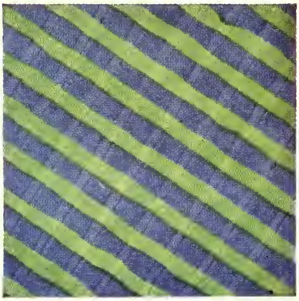
(1) Base dyed blue, then over-printed with greasy resist in lines.



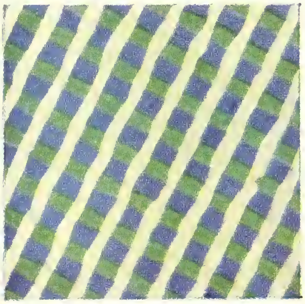
(2) Blue bleached out.



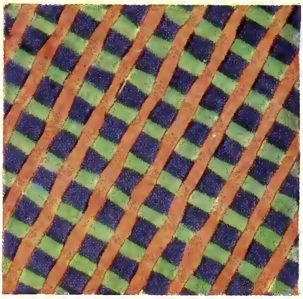
(3) Dyed green.



(4) First resist washed off and reprinted in lines at right angles to the first set.



(5) Bleached again.



(6) Dyed red and resist removed to give final reseau.

These photomicrographs were taken on Dufaycolor Film, the reproductions being made from the transparencies.

In this way the image is broken up into three sets of minute areas which represent respectively the red, green and blue components of the subject photographed.

Consider now a red object photographed on Dufaycolor Film; the red light passes through the red areas of the réseau but is stopped by the green and blue areas. On development there will be a black silver deposit behind each red filter element, the silver bromide behind the blue and green elements being unaffected. The next step in the processing of the film is the bleaching operation, which dissolves away the developed silver without affecting the unexposed areas. An even exposure to white light is then given to make these unexposed areas responsive to a final treatment with developer, which converts all the remaining silver bromide to silver. Thus it will be seen that there is now a black silver deposit

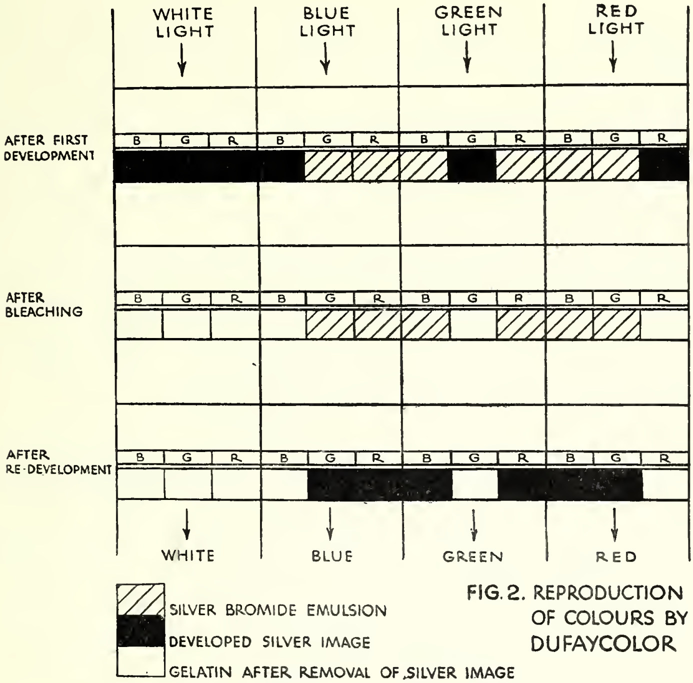


FIG. 2. REPRODUCTION OF COLOURS BY DUFAYCOLOR

behind both the blue and green areas. When the film is illuminated the light can only pass through the red filter elements and thus an accurate representation of the original red object is obtained. Similar reasoning applies to the reproduction of any other colour and the three colour elements employed are such that all colours can be reproduced (see Fig. 2).

The fineness of the réseau pattern avoids any coarseness or graininess in the image when viewed in the hand or when projected on the screen, provided the magnification is not excessive.

Since the final colour picture is formed in the eye by adding together the light transmitted by all the separate colour elements of the réseau, this process is known as additive colour photography.

The principles of this form of photography were first laid down in 1869, while the first colour plates were manufactured in 1895, and throughout this period up to the present day many improvements have been made. Dufaycolor is the latest of this long line of processes and is the outcome of continued and concentrated research, which has been carried on with the sole purpose of obtaining accurate colour rendering combined with an easy method of manipulation.

Dufaycolor takes its name from M. Louis Dufay, who manufactured the Dufay Diopticolor and Dioptichrome Screen Plates in 1908 and has since been engaged in the developing of a colour matrix on film sufficiently fine to be applicable to colour cinematography. Such a process could not reach perfection without the expenditure of large sums of money and much co-operative scientific research, both of which have been made available by the foresight of Spicers Ltd. and Ilford Limited, who have co-operated in the development of this process and have brought it to its present stage of perfection. Intensive experimental work is proceeding and constant improvements are being made.

The Advantages of Dufaycolor

Dufaycolor is the most perfect system of additive colour photography yet devised in that it combines the following improvements over all previous processes:

(1) Considerable increase in speed, permitting snapshot exposures with ordinary inexpensive cameras under a wide range of conditions.

(2) Greater latitude in exposure.

(3) Finer and very much less obtrusive colour screen elements.

(4) Absence of frilling and blistering.

(5) Absence of parallax.

(6) Ease with which three-colour separation negatives can be made for preparing colour photographs on paper or colour blocks for machine printing by any process. Monochrome negatives can be made, and from them black and white prints either by contact or by enlargement.

(7) Ability to make duplicate transparencies without serious loss of colour.

Types of Dufaycolor Film

There are two types of Dufaycolor Film:

Type D.1 ..	Roll Films, Film Packs, Films for Miniature cameras, and 9.5 mm. and 16 mm. films for sub-standard Cinematography.
Type D.2 ..	Flat Film.

Note:—Variations of this method of packing cannot be undertaken, thus Type D.2 material will NOT be packed as Roll Film, etc.

Type D.1 Dufaycolor Film is suitable for exposure in daylight *without any filter* and is therefore particularly suitable for the amateur user. A filter is necessary for light other than daylight.

Type D.2 Dufaycolor Film *requires a filter under all circumstances* (see page 10). It has been decided to market this type of material for Dufaycolor Flat Film because the highest possible speed and colour correction is obtainable in this way, with the various light sources which may be used in practice. Flat Film therefore gives the perfection required for technical work. The necessity for using a filter does *not* lead to Type D.2 material with filter being slower than the Type D.1 without filter in daylight.

A further difference is that the Flat Film is on a thicker non-inflammable base to make it suitable for use in large sizes.

SECTION II

WORKING INSTRUCTIONS

Loading

Type 1 Material

Dufaycolor is exposed through the base and therefore the emulsion (dull) side of the film must face away from the lens when the material is in the camera. Dufaycolor Roll Film, Film Pack, 9·5 mm. and 16 mm. Ciné Film and film for Miniature Camera in daylight loading cassettes are all packed so that they automatically take up the correct position in the camera. In placing refills into miniature camera cassettes care should be taken to ensure that the coil of film is wound with the emulsion facing outwards.

Type 2 Material

Owing to the extreme speed and colour sensitiveness of the emulsion on Dufaycolor Film, it is desirable to carry out the operations of loading Flat Film into dark slides *in complete darkness*. A little experience will soon enable this to be done. If the bench is clear and the worker stands still there is little difficulty in doing everything by touch. The film is packed six sheets in a box, all facing the same direction, and each piece of film has hinged to it at one end a sheet of black paper of exactly the same size which covers and protects the emulsion-coated side (see Fig. 1). This paper should not be removed until immediately before development, when it should be opened out and a gentle sideways pull will cause the adhesive strip to peel evenly off the film without tearing (see Fig. 3).

Dufaycolor Film must be exposed through the base, and special care must be taken in loading. The base side can be recognised readily in the dark because it is smooth to the touch and is not protected by the paper cover. This side must face the camera lens. Care should be taken not to impress finger prints on the base, since they may be recorded on the emulsion during exposure. Where film holders or sheaths are available, these may be used successfully, but it is important to insert first that end of the film which is attached to the backing paper so that the emulsion is adequately protected from scratches and the paper does not crease.

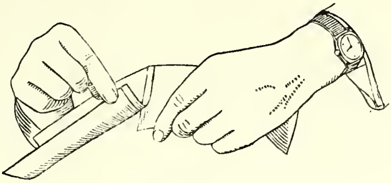


Fig. 3

For use in plate dark slides of the single metal type, the film may be placed with its paper protector in contact with a sheet of thin flat glass and then the edges joined to the glass with narrow strips of thin adhesive tape. If it is preferred to use stiff cardboard in place of glass it is desirable to use best quality cardboard, otherwise the emulsion may be fogged if stored for long in this way.

With some double dark slides it may be better to put the film behind a sheet of glass, that is to say, the glass is inserted first, then the film with its emulsion side away from the glass. This prevents any difficulty due to curling of the film, but necessitates allowance being made for the thickness of the glass when focussing, unless the exposure is to be made at a very small aperture. The thickness of the glass can be compensated for automatically by reversing the ground glass of the focussing screen so that the plain side of the glass is towards the lens.

Filters

Since different light sources vary very greatly in their spectral composition it is necessary in colour work to use a different filter for each type of light. In order to obtain the best results on Dufaycolor Flat Film under all conditions, filters are used with every type of light. (See also page 7).

The following are the filters which are available:—

Light Source	Type D.1 Dufaycolor Film	Type D.2 Dufaycolor Film
Daylight	None	D.2/1
Half-watt lamps—all types including high efficiency (*e.g.*, Nitraphot) and projector type lamps. Also Pointolite..	D.1/2	D.2/2
Photoflood and similar types of lamps ..	D.1/3	D.2/3
Sashalite, Photoflux and similar types of bulbs	D.1/4	D.2/4
Arc light with white-flame carbons ..	—	D.2/5

Flashlight has not been included in the above list for the reason that flash powders of different makes vary greatly in the colour quality of the light emitted by them, and it is impossible to define any one filter for such a variable source. Flash bulbs of the Sashalite type are to be preferred.

IMPORTANT NOTE. In order to prevent errors it is desirable always to refer to filters by their code numbers. Filters made for orthochromatic or panchromatic materials are of no value for Dufaycolor. Dufaycolor Flat Film is supplied with a gelatine filter packed in each box, but other types will be supplied alternatively if required, without extra charge.

Filters are supplied in the form of gelatine film. It is essential that they should not be buckled or have finger marks, as they may then produce double images and other defects. They should be handled only by the edges and stored between sheets of paper, and should not be stuck to any support. The most satisfactory way of employing the gelatine filter is to place it between the lens components.

It should be pointed out that a Dufaycolor transparency will look correct in colour only if viewed in daylight, no matter what light was used for exposing, provided the correct taking filter was employed. If it is desired to view in any other light, a suitable compensating viewing filter should be used (see page 37).

Focussing

Focussing is very important since transparencies which are not quite sharp are usually very ineffective. As mentioned previously the emulsion is on the back of the film during exposure. With the ordinary type of camera with a lens aperture *f*/4·5 or smaller this will have no effect, but when lenses of very large aperture and short focal length are employed special care will be needed to ensure correct focussing. It is also very important that the film should be held flat and in the correct plane. If results are obtained which are not sharp the method of holding the film should be examined.

Exposure

To obtain first-class colour transparencies, considerable accuracy in exposure is essential, even though Dufaycolor Film has greater latitude in this respect than any other colour-screen process. Variations in exposure of at least 8 to 1 will not cause serious divergencies in the colour positives if they are processed individually in accordance with the methods given here. If all exposures are developed for a fixed time, the latitude is of the order of 4 to 1, but can be increased by subsequent reduction or intensification. Nevertheless, transparencies of maximum brilliance will only be obtained by correct exposure.

Hence, we wish to stress the importance of accurately estimating all exposures. Success in this direction may depend very largely on personal skill and experience, but the following notes will enable this experience to be gained very rapidly. The table given below will be found to be a reliable guide for all outdoor exposures on Dufaycolor, but it will be noticed that special categories are not given for different types of subjects since in colour photography the correct exposure remains the same whether the subject is relatively near to or far from the camera and whether or not the subject includes shadows; this is because exposure should be correct for the highlights. Hence, subjects including both very dense shadows and strong high-lights should be avoided as far as possible. The times given below are for the film in conjunction with its daylight filter in the case of the Type D.2 material, or without filter in the case of Roll Films, etc., Type D.1.

	f/4	*f*/5·6	*f*/8	*f*/11	*f*/16
Beach and sky scenes ..	1/200	1/100	1/50	1/25	1/10
All outdoor subjects in sunlight except the above	1/100	1/50	1/25	1/10	1/5
All outdoor subjects on bright days with sun obscured	1/50	1/25	1/10	1/5	1/2
All outdoor subjects on dull days	1/25	1/10	1/5	1/2	1

These exposures are correct for the middle hours of the day during the summer months. For other times and seasons multiply by the following factors:—

Time of day (not summer time).	April, May, June, July, August.	March, September.	February, October.	November, December, January.
a.m. p.m.				
10 to 2	1	2	2	4
8–10 or 2–4	1	2	8	–
6–8 or 4–6	2	4	–	–

As further useful evidence of the speed of Dufaycolor to daylight it may be said that it requires approximately twice the exposure necessary for ordinary Roll Film or four times that for Roll Film of the "Chrome" type, when the exposure for the latter materials yields well-exposed negatives.

Naturally, the use of a reliable exposure meter will give greater accuracy than is possible with either of the above methods.

Exposure Meters

Photo-electric exposure meters are particularly applicable to reversal processes such as Dufaycolor, because in a reversal process where a printing operation is not introduced, it is desirable to expose for the high-lights and to allow the shadows to take care of themselves.

Photo-electric meters are affected to a greater extent by changes in brightness of the high-light portions of the picture than by changes in the depth of the shadows, and consequently with an average subject they automatically indicate the correct exposure for the reversal process.

Take, for example, an average subject yielding a meter reading which is correct for reversal and negative exposure. Now imagine the same subject with deeper shadows. The meter will give almost exactly the same reading and the reversal exposure should be the same, but the negative exposure will have to be increased several times to record the detail in the shadows.

In negative work these corrections are applied by multiplying the indicated exposure by factors for type of subject (depth of shadow) etc.; these corrections should not be used for Dufaycolor, but it must be realised that neither for negative nor for direct reversal work is the photo-electric exposure meter infallible, and the user must make allowance for subjects which cannot be described as "average"; if, for example, the subject contains a predominating area of high-light or deep shadow which is not, however, the part of the picture which it is most desired to reproduce accurately, *e.g.,* a head against a cloudy sky, or brightly lit figures in a sunlit glade, the meter should be directed towards a part of the scene which may not be included in the field of the camera but which is illuminated in the same way as the important part of the picture and does not include large areas of high-light or shadow; *e.g.,* direct the meter downwards to avoid the sky in the case of the first example, and approach the figures and direct the meter downwards in the glade to exclude dark areas not illuminated by direct sunlight in the second example.

Any of the well known types of exposure meters may be used, but as the speed scales used on different instruments vary, the speed factors for use with Dufaycolor given by the makers of the more commonly known meters are given overleaf.

Photo Electric Meters

	Speed
Avo	400 H. & D.
Blendux	17° or Class C
Bewi	17° Scheiner
Electrodrem	24° Scheiner
Ilford	Group C
Leicameter	17 Weston Scheiner
Ombrux	17° Scheiner
Photoscop	17° Scheiner
Prinsen	400 H. & D.
Sixtus	15/10 DIN in full sunlight
,,	9/10 DIN other exposures and indoor
Tempiphot	19° Scheiner
Weston	8 Normal subject

Extinction Meters

Leudi	22° Scheiner
Justophot	16—19° Scheiner
Justodrem	20—23° Scheiner

Sensitive Paper Meters

Wynne's Infallible	F78
Watkin's Bee	65

For indoor subjects in artificial light, the technique described above is not satisfactory because subjects cannot in general be taken as average. In a portrait, for instance, the indicated exposure has been found to vary by as much as four times according to the material of the dress being worn by the sitter, the correct exposure, of course, being the same throughout. The following method is advised.

The subject is lit as required, and a piece of white blotting paper, preferably 22″ × 15″, and not less than 15″ × 12″, is held in front of the principal part of the picture. The exposure meter is brought up to the blotting paper from the direction of the camera, care being taken to ensure that the shadow of the operator's body is not cast on the paper. As the meter approaches the paper in this manner, it will be found that the reading gradually reaches a maximum at a distance of about 1 foot from the paper, and after this, begins to fall off owing to the existence of the shadow cast by the meter itself. The maximum reading is taken, the meter having been set as for use with Dufaycolor in daylight, and the exposure indicated is multiplied by 40. This gives the exposure necessary in Half-Watt or Photoflood light when using Dufaycolor Film with the appropriate compensating filter. (This factor of 40 times may sound very high, but it should be remembered firstly, that we are taking the reading of light reflected from white paper, and, secondly, that the sensitivity of the photo-cell is very much greater to red light than to blue, with the result that it indicates very short exposures with half-watt light.)

For further notes on Photoflood lighting see pp. 29 & 30.

Points to Remember

In colour photography it is well to remember the following points:—

It is not necessary when using Dufaycolor material to seek for brightly coloured objects to photograph. Dufaycolor should be employed in the normal way, photographing the ordinary colours met with in Nature, when the most pleasing effects will be obtained.

The best transparencies are usually those taken with the lens at a wide aperture; therefore, do not stop down much, unless it is essential to do so to obtain depth of focus.

Strong contrast in the lighting is not required, as the colour provides the contrast.

Brilliant sunshine gives a bright picture, but heavy shadows may result which are not always pleasing.

Large masses of colour are more effective than small scattered patches.

Colour pictures should, if possible, be taken with the light behind the camera: photographing against the light is often disappointing.

Under-exposure leads to dense results and hard contrasts, while over-exposure gives light colours and lower contrasts, unless the errors in exposure are subsequently corrected by the development technique recommended here.

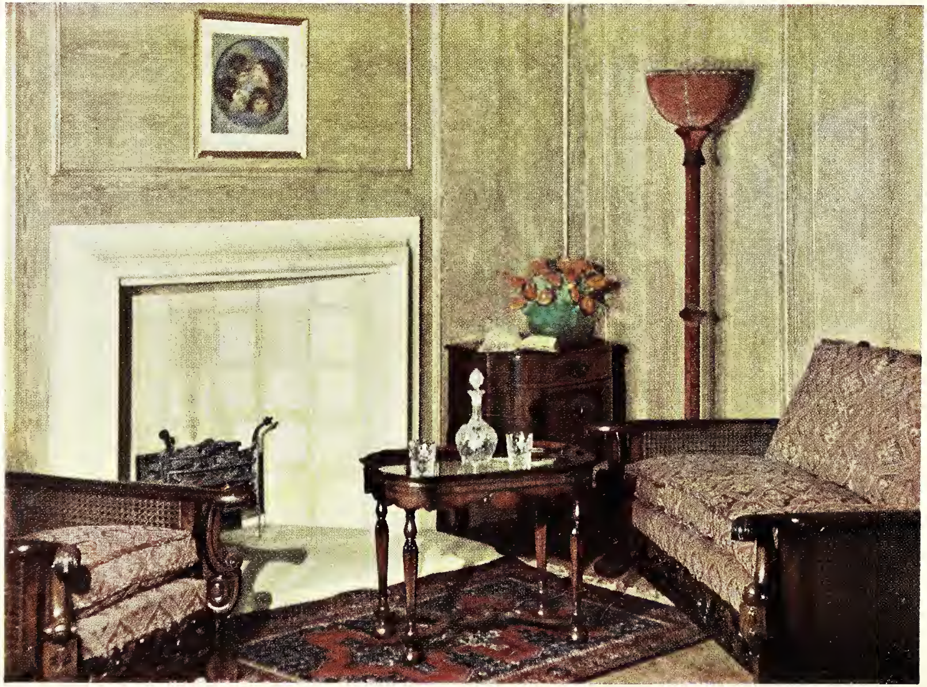
Processing

The development technique and subsequent treatment recommended in the following sections of this booklet are applicable to both the Type D.1 and Type D.2 materials.

Arrangements have been made by Dufay-Chromex Limited for the processing of all forms of Dufaycolor Films. It is expected that customers using Dufaycolor Roll Films will in general make use of the facilities thus offered to them, and for this reason processing instructions are not issued with these materials. 9·5 m.m. and 16 m.m. Ciné Film is sold at a price which includes the charge for processing. In the case of Film Packs and Flat Films, full processing instructions are enclosed in each box, but the following pages give further information which will enable even the novice to carry through the necessary operations with success.

It is important to follow closely the instructions given here, since only in this way will the best results be obtained. Dufaycolor Film possesses the valuable property of withstanding continual treatment in a variety of baths under all normal conditions without frilling, blistering, or other defects; therefore, it will be found quite easy to carry out the processing operations. The so-called reversal method of processing must be employed to produce a colour transparency (positive) from the piece of Dufaycolor Film which is actually exposed in the camera. On developing, a negative image is first obtained but, instead of fixing at this stage, the black silver negative image is dissolved out in a bleaching bath, the remaining silver bromide is exposed to light during the second exposure and then redeveloped to give the final positive. This procedure presents no difficulty in practice and can be carried out by any amateur. A point worth noting is that Dufaycolor Roll Film as taken from the spool, tends to curl with the emulsion side outwards and when the film is allowed to take its normal curl during see-saw development, care must be taken to prevent the emulsion surface coming into contact with the bottom of the dish lest it should thereby become scratched. As soon as the film becomes thoroughly wetted by developer it is possible to reverse the curl so that the film may be see-sawed with the emulsion surface upwards. This procedure should always be followed.

The use of most ordinary developers on Dufaycolor Film will lead to failure, and it is therefore desirable to use the developer formula recommended and to follow the instructions closely.



By courtesy of Waring & Gillow (1932) Ltd.

Room illuminated by two 500 watt lamps in reflectors and one 500 watt spot. Exposure 3 minutes at F/11 on Dufaycolor Flat Film through D2/2 filter.

Blocks by John Swain & Son, Ltd., Screen negatives made direct on to Ilford Rapid Process Panchromatic Plates through Ilford Tricolour Filters. 150 line Screen.

For the convenience of different types of workers, two alternative development techniques are given. Where the work is mainly repetitive or the conditions of lighting are standardised, the exposures should be accurate and a standard development time will give the best result. Should errors in exposure occur the resulting transparencies will be too thin or too dense and can be partially corrected by reduction or intensification, as explained on page 21 *et seq.*

For the amateur or other outdoor worker who cannot control his exposures so accurately, a method of Factorial Development is of great value, since small errors in exposure are automatically compensated for and larger errors are made to yield the best results obtainable under the circumstances without the necessity for any after treatment. But if Constant First Development is preferred, the after-treatment can be made to yield as high a percentage of good results as would be obtained by Factorial Development.

Whichever method is employed great care must be taken to avoid fogging, as the speed of the emulsion is exceptionally high. Uniform fogging, as from an unsafe darkroom lamp, is not readily detected, as it does not lead to veiling in the ordinary sense, but causes a general flattening of gradation and colour, together with a loss of density.

CONSTANT FIRST DEVELOPMENT METHOD. Work in total darkness or with an Ilford "G" Safelight shielded so that the direct light cannot fall on the film.

Immerse in one of the following developing solutions, taking care that the dish is being vigorously rocked the whole time. Agitation greatly increases the brilliance of the transparencies. With Formula A, development should be continued for three minutes at 65°F. (two-and-a-half minutes at 70°F. or two minutes at 75°F.). When using Formula B it is well to allow 20 per cent. longer time in each case. Formula B gives slightly more contrasty results than A and has the advantage that the thiocyanate is a more constant and stable chemical than ammonia. When using the formula A it is important to ensure that the ammonia is up to its labelled strength.

DEVELOPER A

Metol	130 grs.	or	6·5 gms.
Sodium Sulphite (cryst.)	4 ozs.		100 "
Hydroquinone	40 grs.		2·0 "
Potassium Bromide	50 "		2·75 "
Ammonia (Sp. G. 880)	210 minims		11 c.cs.
Water up to	40 ozs.		1000 "

DEVELOPER B

Metol	130 grs.	or	6·5 gms.
Sodium Sulphite (cryst.)	4 ozs.		100 "
Hydroquinone	40 grs.		2·0 "
Sodium Carbonate (cryst.)	4 ozs.		100 "
Potassium Bromide	50 grs.		2·75 "
Potassium Thiocyanate (sulphocyanide) (pure)	160 grs.		9 "
Water up to	40 ozs.		1000 c.cs.

It is important that the chemicals should be dissolved in the order given. Alternative ammonia strengths are Ammonia Sp. G. 910=290 minims or 15 c.cs.; Solution of Ammonia B.P.=1 oz. 170 minims or 34 c.cs.

These developers do not keep indefinitely; if a stock solution is to be kept, then formula B is preferable, but it is not advisable to use this if more than two or three weeks old. If old developer is employed rather weak and flat transparencies will be obtained.

It is preferable to use fresh developer for each film unless several films are developed at the same time; the used developer may, however, be employed again for the second development process (see page 22).

When it is desired to develop a number of films together it is essential that they should be held on some rigid support so that they do not overlap one another and to ensure that the edges do not curl out of the solution. A sheet of Ilford Filmflat mounted on glass can be used, the film being squeegeed into contact with this before commencing development, when it will adhere firmly. When processing is completed the film is stripped off and the Filmflat thoroughly dried, when it is ready for re-use.

FACTORIAL FIRST DEVELOPMENT METHOD. For Factorial Development to be employed, it is essential to desensitise the emulsion in order that the progress of development can be watched. While there are a number of desensitisers available, they are not necessarily all suitable for use with the special developers containing silver solvents employed for the reversal development of colour films.

For Desensitising immerse the film in total darkness in a 1 : 2000 solution of Pinacryptol Yellow for two minutes and then rinse for one minute and transfer to the developer.

After desensitising, the Ilford Iso Safelight (red) should be employed, and, using this safelight in a darkroom lamp containing a 25-watt bulb, the film should not be exposed to its light for long periods, nor at a shorter distance than three feet.

The Development Technique recommended is as follows:—Take two dishes and in the first put one part of either of the developers given above and three parts of water, and into the second dish pour full strength developer. After the two minutes desensitising and one minute rinsing, transfer the film to the weak developer and note the time required in seconds for the first appearance of the image. The brightest high-lights, such as sky, etc., can be ignored. Immediately this time has been noted transfer the film to the full strength developer and continue development without further inspection for a period equal to three times the period in the first bath. The dish should be rocked continuously throughout the whole period of development.

It is not satisfactory to give less than two minutes or more than five minutes in the full strength developer at 65°F., as this would indicate that the film is so far over- or under-exposed as to be beyond correction by this method; at higher temperatures development for rather less than two minutes may be required for a fully exposed film.

BLEACHING BATH. After development rinse the film for about two minutes or place immediately in a one per cent. solution of acetic acid to stop development. Then transfer to the following bath for five minutes until all the negative silver image is dissolved.

Potassium Permanganate . .	. . 40 grs.	or	2 gms.
Sulphuric Acid (conc.) . .	. . 200 minims		10 c.cs.
Water up to . .	. . 40 ozs.		1000 c.cs.

It is important to agitate the film during the bleaching operation.

In making up this solution it should be remembered that the permanganate may take some hours to dissolve completely, and the sulphuric acid should be added a few drops at a time and not suddenly. It is desirable to use water free from any appreciable quantities of chlorides and either distilled or rain water should be used for this purpose. The solutions should not be kept after use.

White light may be turned on in the darkroom when the film has been in the bleaching bath for about one minute, and all subsequent operations carried out in the white light.

CLEARING BATH. After bleaching, the film is well washed and placed in the following bath until the brown stain has disappeared:—

Potassium Metabisulphite	1 oz.	or	25 gms.
Water up to	40 ozs.		1000 c.cs.

ALTERNATIVE BLEACHING BATH. Some workers prefer the bichromate bleach because it is more stable and no clearing bath is required after it, thus obviating one operation. If the bichromate bleach is used the resulting Dufaycolor transparencies will be definitely softer and more degraded in colour.

Bleaching requires three to five minutes in a bath prepared by diluting 1 part of the following solution with 10 parts of water.

Potassium Bichromate	2 ozs.	or	50 gms.
Sulphuric Acid conc.	4 ,,		100 c.cs.
Water up to	40 ,,		1000 ,,

Dissolve the bichromate in the water first and then add the sulphuric acid.

REDUCTION OF DENSE TRANSPARENCIES. When the film is viewed in white light after bleaching it will be obvious whether or not the exposure has been satisfactory. A correctly exposed film will show the brightest portions of the high-lights as almost dead black when the film lies face up in the dish: this is because the image in these portions should be almost free from silver bromide. If on the other hand the high-lights are covered with a white veil it follows that the exposure has been too short, or if Factorial Development has been employed the correction has either been insufficient or the exposure so short that adequate compensation is impossible. On redevelopment this white veil will yield a silver deposit, so that the transparency will either be flat or unduly dense. This can be avoided and the transparency consequently improved by carefully regulated reduction before the second development, but if the reduction has to be carried far the picture will tend to be unduly soft in contrast. This treatment is of great value in practice and was employed as long ago as 1909, when it was included in the instructions for the Thames Colour Plate, but more recently it has been less employed than its obvious merits would warrant.

The best reducing agent is a very dilute solution (1 : 1000) of potassium cyanide; a stronger solution acts too rapidly. This substance is extremely poisonous and must therefore be handled with care; those who prefer not to use cyanide can employ a 1 per cent. solution of hypo or a 2 per cent. solution of ammonium thiocyanate (sulphocyanide), but these give less satisfactory results. The film is immersed in the reducing solution and gently rocked until the high-lights are almost clear, but are still just covered with a slight milky deposit; the action is stopped by transferring to water. After examination by diffused transmitted light to ensure that the result is correct, the film is *rinsed thoroughly* and the Second Exposure and Redevelopment proceeded with.

SECOND EXPOSURE. After bleaching, whether the first or second method is employed, the film is washed for one to two minutes and then exposed for about four minutes at three feet, or twenty to thirty seconds at one foot, from a 100-watt lamp. The exposure should be to the emulsion side of the film, which may be under water or placed face down on a sheet of glass and exposed through the glass, or the film may be flat in the bottom of a dish with the water drained off; however the exposure is made it is desirable that drops of water should not be present on the surface. It is not advisable to take the film out into bright daylight, as excessive exposure produces degraded high-lights.

REDEVELOPMENT. The film should preferably be redeveloped in the used First Developer (full strength), the operation requiring about four to five minutes. Alternatively, the film may be developed in any quick-working metol-hydroquinone developer, but care should be taken to develop to completion.

FIXATION AND WASHING. Finally, after rinsing, the film is fixed for two minutes, thoroughly washed for about fifteen minutes and dried. The fixing bath removes insensitive silver halide from the high-lights, but should not affect the general density of the transparency. Reduction in density indicates insufficient second exposure or incomplete second development. Fixation is not essential if the First Developer containing a silver bromide solvent (ammonia or potassium thiocyanate) is used for redevelopment. The colours of the image will have been visible from the time the film came out of the reversing bath, but they will not appear in their full brilliance until after redevelopment and fixation. Owing to the swollen nature of the gelatine the image will not be free from a trace of parallax until after it is dry, and care should be taken, therefore, to view the wet transparencies from immediately in front.

DRYING. Any drops of water adhering to the back of the film should be removed with a pad of wet cotton wool in order to prevent drying marks. The films should be hung up where nothing can touch the surface and drying should preferably be effected in a current of warm air. It is not necessary to varnish the transparencies and it will be found that they are not easily damaged in the dry state.

PROCESSING IN WARM SOLUTIONS. When processing in this country during the hotter weather, with the temperatures of the solutions somewhat above 65°F., it may be advantageous to use a hardening bath immediately after the first development. For this purpose a 2½ per cent. solution of chrome alum in water is recommended. After development the film should be washed for one minute and placed in the hardening bath for five minutes. It should then be well rinsed before being transferred to the bleaching bath.

In all cases where processing solutions are above 75°F. special precautions must be taken to harden the film. There are two alternatives—the normal processing technique may be adhered to and a special formalin hardening bath used immediately after the first development.

Formalin 40 per cent. solution	1 oz.	or	25 c.cs.
Caustic Soda	30 grs.		1·5 gms.
Sodium Sulphate	6 ozs.		150 gms.
Water up to	40 ,,		1000 c.cs.

After rinsing, transfer to the bleaching bath and proceed as before.

Formalin is the only efficient hardener which can be used with the normal processing technique when the temperatures of the solutions are above 75°F. but its use tends to promote poor adhesion, and for this reason the formalin bath should be, wherever possible, avoided. This can be done either by keeping the temperatures of the processing solutions down to such an extent that this special hardening need not be employed, or by adopting the following system of processing, this system being satisfactory for temperatures up to 80°F.

To the normal first developer sodium sulphate is added in the proportion of 100 gms. per litre, and to compensate for this addition development times are increased by fifteen seconds in every case, the increase being independent of the temperature.

After development, a short rinse is given, and the film is transferred to the following hardening bath for ten minutes, care being taken to agitate the film during the first minute, a precaution necessary if stains are to be avoided.

Chrome Alum	1 oz.	or	25 gms.
Sodium Sulphate	4 ozs.		100 gms.
Water to	40 ozs.		1 litre

The film is rinsed for a few seconds and transferred to the permanganate bleaching bath until all the silver is dissolved. Agitation is again absolutely essential, especially during the first thirty seconds. Bleaching should be complete in two minutes at 80°F., and if the bleaching time becomes longer than three minutes at this temperature, a new bath should be made up. After a short rinse the film is immersed in 2½ per cent. Potassium Metabisulphite until the brown stain has disappeared. The film is washed for two minutes, and then re-exposed as already described.

Redevelopment is carried out in the following acid developer, and should be complete in four minutes at 80°F.

Amidol	200 grs.	or	10 gms.
Sodium Sulphite (cryst.) ..	1¾ ozs.		40 gms.
Potassium Metabisulphite ..	100 grs.		5 gms.
Water to	40 ozs.		1 litre

This developer keeps in good condition in tanks for from two to three days. The film is again rinsed and cleared for one minute in an acid fixing bath, and is then hardened for ten minutes in the chrome alum sodium sulphate hardening bath already referred to in this section. The film is finally washed for from ten to fifteen minutes in running water.

At high temperatures the development time becomes rather short and Factorial Development is not recommended. At 75°F. a development time of two minutes is satisfactory, but when the developer must be used hotter than this it is preferable to dilute with an equal volume of water and develop for three minutes at 80°F. or two and a half minutes at 85°F. When using developer B 20 per cent. should be added to each of these times.

CORRECTING FOR OVER-EXPOSURE AND EXCESSIVE DEVELOPMENT—INTENSIFICATION

Many of the usual methods of intensification may be employed, but some are not easy to control; the most suitable is the Mercury Intensifier, in which the image is bleached in:

Mercuric Chloride	100 grs.	or	6 gms.
Potassium Bromide	100 grs.		6 gms.
Water to	10 ozs.		250 c.cs.

The film is bleached right through, and this should take about three minutes. It is then washed for ten minutes in running water and blackened in 5 per cent. sodium sulphite solution for about three minutes. The film should then be well washed and dried.

CORRECTING FOR UNDER-EXPOSURE AND INSUFFICIENT DEVELOPMENT—REDUCTION

If reduction has been carried out as recommended above after bleaching but before the second exposure, further reduction should be unnecessary; similarly if Factorial Development has been employed, little further improvement can be effected by reduction as the transparency is merely made weaker.

However, if it is preferred to carry out reduction as an after treatment, either of the following methods will be found satisfactory.

(1) Immerse in the following bath until sufficiently reduced:—

SOLUTION A

Hypo	1 oz.	or	10 gms.
Sodium Carbonate (cryst.)	$\frac{3}{4}$ oz.		8 gms.
Water	20 ozs.		200 c.cs.

SOLUTION B

Potassium Ferricyanide	50 grs.	or	1 gm.
Water	20 ozs.		200 c.cs.

For use mix equal parts of A and B.

It is important that these concentrations are adhered to. The carbonate increases the life of the bath so that, unlike the usual Farmer's Reducer, the mixed solution remains usable for hours. If the carbonate is omitted, the solution must be used immediately after mixing. When the density appears correct by visual examination the film is removed and washed for ten minutes.

(2) For under-exposed transparencies of high contrast, bleach in:—

Potassium Permanganate	60 grs.	or	3 gms.
Acetic Acid	2 ozs.		50 c.cs.
Sodium Chloride	120 grs.		6 gms.
Water to	40 ozs.		1000 c.cs.

After bleaching, the transparencies are cleared in a 5 per cent. Metabisulphite bath and redeveloped in normal Amidol developer.

SECTION III

DUFAYCOLOR AND ITS APPLICATIONS

Owing to the high speed and ease of handling of Dufaycolor Film, it can be used in almost all branches of photography. That is to say, wherever black and white photography has been used up to the present and the retention of the colour of the original would enhance the effect, then it is almost certain that Dufaycolor can be applied successfully.

In the following sections a few hints are given with regard to uses of Dufaycolor Film, but no attempt is made to give an exhaustive list of the applications of this wonderful new photographic material. The instructions given in this booklet should be sufficient in most cases to indicate a method of handling Dufaycolor which will lead to successful results, but if difficulties are encountered Dufay-Chromex Limited will be pleased to assist if full details of the problem are sent.

Dufaycolor for the Amateur

Dufaycolor Roll Films and Film Packs (Type D.1) have been manufactured primarily for the use of the amateur photographer and they are so designed that no filter is required for exposure in daylight; they are suitable for use in existing roll film and plate cameras. For those requiring Flat Film the Type D.2 material is available, and must be used with its appropriate filter. The advantage of the flat film material will be noticed chiefly when exposures are made to a light other than daylight.

An examination of the exposure table on page 12, which applies equally to the Type D.1 and Type D.2 materials, will show that successful snapshot exposures (1/25th second) can be made whenever the light is bright, except with lenses of very small aperture. Hence there is no more difficulty in exposing Dufaycolor than in exposing any other material, but to ensure a high percentage of successful results it is essential that exposures should be approximately correct, as there cannot be the same exposure latitude in a colour process as there is in ordinary black and white photography.

Where conditions make it imperative the photograph can be taken with any arrangement of light and subject, but since the object of photography is to obtain the most pleasing result, it will be found that careful selection of subject and direction of lighting will play a big part in ensuring success. The hints given on page 14 concerning suitable lighting, etc., for taking Dufaycolor transparencies are well worth careful consideration.

Dufaycolor for the Miniature Camera User

The popularity of the miniature camera is now universal and arises largely from its compactness and adaptability. Dufaycolor Film is ideal for the miniature colour picture; it is fast, enabling moving subjects to be taken, no filter is required in daylight, the grain is fine so that detail is not unduly broken up, the images are brilliant and stand out well, while successful subjects will stand considerable enlargement. Particularly pleasing effects are obtained by the projection of 35 mm. Dufaycolor positives taken in Leica, Contax, or similar cameras, and this is one of the best methods of showing colour transparencies to a small audience.

These small cameras, being invariably fitted with high-class lenses of wide aperture, yield colour positives of the maximum brilliance, in which a surprising wealth of detail and colour is visible. To obtain the best effect, however, from these transparencies, it is well worth while to frame either the individual picture or the strip with a fairly wide black margin to cut off extraneous light. This makes a marked difference to the appearance of all transparencies but, naturally, it is of greater importance when the eyes are focussed on to a particularly small image.

Dufaycolor for the Amateur Cinematographer

Dufaycolor is the simplest possible method of colour cinematography, since no additional apparatus is required and no special precautions are necessary except to adjust the lens stop appropriately and employ a suitable filter.

For exposures on open subjects in bright sunlight the following stops will be found suitable:—

Winter	*f*/3·5
Spring and Autumn	*f*/4·5
Summer—ordinary sunshine	*f*/5·6
Summer—bright sunshine	*f*/8
Summer—open sea	*f*/11

Naturally, subjects in shadow or with strong foregrounds require more exposure. In general the lens aperture should be opened to one stop larger than would be employed when photographing on a normal panchromatic film and to two stops larger than for Hypersensitive Panchromatic Film.

It is not necessary to go further into the details of this subject here, since those interested can obtain additional information on application to Dufay-Chromex Limited.

It should be noted that Dufay-Chromex Limited undertake the processing of this material at their Dufaycolor Processing Station, and not only are films in colour readily obtainable but the colours are brilliant, will stand considerable enlargement on the screen, and the pattern of the réseau is not noticeable on projection except when the observer is close to the screen.

Dufaycolor for the Portrait Photographer

Portraiture is for the most part carried out in artificial light, and the essential point to remember is that a different filter will be required for each type of light, and according to whether type D.1 or type D.2 Dufaycolor is being employed. For this reason it is important not to mix the types of light employed. For instance, half-watt lighting together with an arc spot-light, which may be suitable for normal monochrome portraiture, would be quite fatal with Dufaycolor, because whatever filter was used on the lens some portions of the picture would necessarily be wrong in colour. Similarly, mixtures of daylight and half-watt light must not be employed. Another important point which must be taken into consideration is that part of the contrast in Dufaycolor arises from differences in colour, as well as from differences in black and white contrast, and hence modelling is less dependent on the artificial formation of light and shade by means of controlled lighting than is the case with monochrome photography.

As a general rule we would recommend the beginner in colour portraiture to employ a somewhat flat lighting because this can be relied upon to give a pleasing effect without the excessive contrast which is often produced by the incorrect positioning of spot-lights, etc. This can then be followed by careful experimenting with various lighting systems when it will be found that the judicious application of modern lighting methods can give vastly improved results. Further, to obtain the best results very careful consideration must be given to the colour composition of the picture, since in colour work this is even more important than the spacial arrangement of the subject and background.

To half-watt light Dufaycolor with its appropriate filter is not as fast, relative to other panchromatic materials, as it is to daylight; hence exceptionally short exposures by half-watt light must not be anticipated.

Since the intensity of the light on the subject falls off as the square of the distance from the light source, it is desirable to have the lights as close up as possible; general lighting far from the subject is of comparatively little value.

Photoflood lamps are likely to prove of considerable value to the photographer employing Dufaycolor because (*a*) the output of light is considerably higher than with half-watt lamps for an equal current consumption, (*b*) the light is bluer and approximates more nearly to white light so that it is more effective from the point of view of colour photography; hence (*c*) a paler filter can be employed so that the necessary exposure time is further decreased. For these reasons one Photoflood bulb of a nominal rating of only 275 watts is found to have about half the photographic efficiency on Dufaycolor film of a 1500-watt half-watt lamp when both are used in the same reflector; but owing to the small size of the

Photoflood bulb it is usual to use a small reflector without any diffuser, which directs the light towards the subject very efficiently and enables the exposures to be still further reduced. For these reasons the equipping of studios with a liberal supply of Photoflood bulbs will allow very short exposures to be obtained with the minimum of equipment and very low current consumption.

Sashalite bulbs may also be used with success, the necessary exposures being indicated in the accompanying table.

Distance of Bulb from Subject	Bulb	Reflector
8 feet	Baby	Small
12 feet	Large	Small
12 feet	Baby	Large
16 feet	Large	Large

The above table gives an indication of the type of bulb and reflector which will be necessary to secure good exposures when working at an aperture of *f*/4·5. One bulb only is required in each case, and the data given apply when the correct filter is used with the film.

For more complete data with regard to exposures necessary for the various types of artificial light, the booklet entitled "Home and Winter Photography with Dufaycolor" may be consulted.

Dufaycolor for the Commercial Photographer

Owing to the wide range of conditions likely to be encountered by the commercial photographer, he should employ only Dufaycolor Flat Film (Type D.2) and be equipped with a suitable range of filters (see page 10). The most important special precautions refer to lighting. As mentioned in the preceding paragraph different types of light must not be mixed, and hard lighting will lead to excessive contrast and may result in lack of detail in either the high-lights or shadows of the transparency.

For difficult subjects or where movement is likely to occur the usefulness of the Sashalite bulb should not be overlooked, while the remarks in the previous section concerning Photoflood lighting may enable subjects such as fashion studies to be taken with considerably shorter exposures than would otherwise be practicable.

Dufaycolor enlarges appreciably the scope of the commercial photographer, since it enables him to supply the originals from which illustrations in colour can be produced readily. Formerly the work of the artist had to be relied upon, except where the object was stationary or could be transported to the studio, but with the high speed of Dufaycolor and the simplicity of reproduction from it, there is no reason why colour reproductions of moving objects should not be much more widely used.

Further, good use can be made of Dufaycolor reproductions of innumerable commercial products. As they are on film they are light and easy for travellers to carry, while they are also convenient for projection before an audience. Large transparencies are ideal for the decoration of exhibition stands.

In colour work it is desirable to make the transparency as large as possible, because facilities for enlarging are not available at present.

Dufaycolor for the Works Photographer

Most large industrial firms have realised the advantages of having a permanent photographer on their staff to make adequate records of all new developments. What is more natural than that these records should be in colour, especially when colour is so often an essential attribute of the subject to be recorded? Nothing is simpler than Dufaycolor for such a purpose. Again, records of this description, together with photographs of the factory or the product, are of immense value to the advertising department, which will welcome colour pictures from which they can have either three-colour or monochrome blocks made as required, thus overcoming the common shortage of suitable originals from which colour illustrations can be prepared.

For most of this work, which is of a technical nature, Dufaycolor Flat Film is recommended.

Dufaycolor for the Press Photographer

Dufaycolor opens up an entirely new field for the press photographer, because in the past the necessary exposures for making colour transparencies have been too long to enable adequate pictures of moving objects to be taken. Owing to the remarkably high speed of Dufaycolor this is no longer the case, provided reasonable care is taken in selecting both the subject and the view-point. This care is necessary because Dufaycolor cannot be as fast as the modern press plate. It is now possible to obtain colour pictures of race meetings, processions, notable personalities, etc., entirely suitable for publication in the weekly and topical press.

For indoor work the use of flash bulbs of the Sashalite type would appear to be preferable to the use of flash powder because different makes of powder differ considerably in the colour of the light emitted, so that the provision of a suitable filter would be a matter of difficulty.

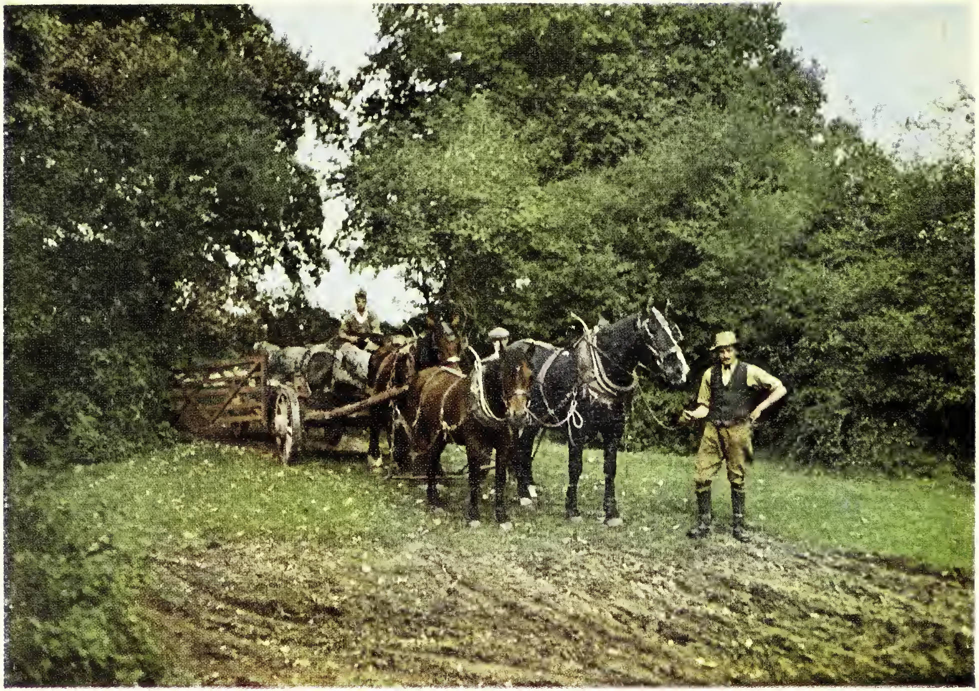
Dufaycolor Flat Film Type D.2 is recommended as more suitable for this class of work than Type D.1.

Dufaycolor for Technical, Scientific and Clinical Photography

The ability to record colour makes possible the photography of many objects which are not easy to record successfully in monochrome, such as subjects frequently met with in photo-micrography which rely on colour contrast rather than on black and white contrast. The fineness of the réseau enables the most minute detail to be retained, provided the transparency is not too small.

The following are a few of the spheres in which Dufaycolor is likely to prove of interest:—

> In the manifold branches of photo-micrography, particularly botanical and zoological specimens, petrological sections, crystals in polarised light, etc.
>
> In spectroscopy for illustrating the phenomenon of absorption in a manner easily understood by the layman. (It will be understood that the production of pure spectral colours is not possible with any three-colour process,



By courtesy of *The Times.*

Dull light, September afternoon. Exposure ½ second at F/8 on Dufaycolor Flat Film through D2/1 Filter.

Blocks by John Swain & Son, Ltd., Screen negatives made direct on to Ilford Rapid Process Panchromatic Plates through Ilford Tricolour Filters. 150 line screen.

but an approximation is achieved with Dufaycolor sufficiently good for the purpose of demonstration.)

In clinical photography it is of special value for recording skin diseases, surface lesions and the like.

It is also particularly applicable to the photography of anatomical specimens and preparations, both normal and pathological.

If the use of contrast filters is desirable to increase the visible contrasts or modify the colours of the object, then such filters can also be used when making Dufaycolor transparencies, provided the appropriate Dufaycolor filter is also employed between the contrast filter and the film. The rendering should then correspond to that visible to the eye through the filter.

Records as described above will be required frequently for lecturing or teaching purposes, for which Dufaycolor transparencies are eminently suitable, particularly in the form of lantern slides, while they are equally satisfactory as originals for reproduction as book illustrations.

Dufaycolor transparencies intended for use as lantern slides should not be unduly dense. Instructions should be given to Dufay-Chromex Limited when sending the films for processing that they are for use as lantern slides, when processing will be suitably modified to ensure the best results for the purpose.

One of the particular advantages of the Dufaycolor process is that copy transparencies can readily be prepared, but this operation must be carried out by Dufay-Chromex Limited, by a special process which has been perfected in their laboratories. Where transparencies are valuable and cannot readily be replaced, it is a good practice to have copy transparencies made and to use the latter, the originals being retained in case further copies are required. Where these copy transparencies are for use as lantern slides, this fact should be stated when the order is given for processing.

Dufaycolor for the Printer

Dufaycolor is of interest to the printer or process engraver in several ways:—

(*a*) For preparing printing plates from existing Dufaycolor transparencies. This is a comparatively simple operation because the fineness of the réseau pattern eliminates difficulties such as graininess or moiré pattern on the images, while the colours of the réseau are such that the negatives taken behind the appropriate filters give a colour separation as good as that obtained on tri-colour negatives taken direct from the object. (For further details see pages 39 and 40.)

(*b*) In the case of objects which cannot be brought to the studio it is a simple matter to take Dufaycolor positives outside, from which the colour separation negatives can be made, thereby saving much of the outside operators' time.

(*c*) Dufaycolor transparencies make excellent colour guides for the colour retoucher or fine etcher and are almost indispensable when the object is too large to be viewed conveniently in the retouching room or where it cannot be retained until the colour proofs are completed. It is therefore a good plan to take a Dufaycolor transparency at the same time as the colour separation negatives; in this way a reproduction is obtained which is brilliant without being harsh, the range of colours which is accurately reproduced is remarkable, while, unlike some other colour transparencies, the grain is so fine that it is invisible when viewed at a normal distance and consequently is not tiring to the eye. For the best method of viewing transparencies for this purpose see page 36.

(*d*) It is often desirable to be able to submit a suggested arrangement or lay-out for the approval of a customer before commencing the work. This is far more convincing if a colour transparency is employed since the colour composition is then shown in a way which is otherwise impossible.

SECTION IV

VIEWING DUFAYCOLOR TRANSPARENCIES

Whilst it is obvious that transparencies can be seen under almost any conditions of lighting, their proper presentation requires the use of suitably diffused lighting, and their appearance can be greatly enhanced by attention to certain details.

Viewing in the Hand

Nothing spoils the appearance of a Dufaycolor transparency more than to examine it against a small source of artificial light, particularly an electric lamp bulb or an unevenly illuminated globe. Also if there is a bright light behind the observer as well as behind the transparency the colours are largely lost. On the other hand, the effect is greatly enhanced if the transparency is surrounded with a black margin, the wider the better, to cut off extraneous light. The first requisite is to mount the transparency in a frame or cardboard mount which should be preferably black and not less than an inch wide all round. Secondly, backing up with ground glass or matt celluloid gives a softened effect and tends to bring out the detail. To obtain a more brilliant appearance the transparency should be viewed in almost parallel light, such as is obtained from a white cloud seen from indoors through a window.

One of the best methods of viewing small transparencies of sizes up to and including three and a half inches square is in one of the Dufaycolor Viewers, of which there are three models, or in one of the simpler viewing devices, *e.g.*, the View-Book, the View Wallet, or the Two-Way View Mount. All these devices accommodate the normal mounted transparencies, and embody a reflecting panel which gives brilliant, diffused illumination of the transparency. When transparencies have to be viewed intensively or for long periods, as when they are used for colour guides in the preparation of printing blocks, then it is advisable to mount them at the end of a black tunnel about twelve inches long, placing a ground glass behind and illuminating suitably.

Dufaycolor transparencies should not be hung up in windows or left lying behind glass in such a way that direct sunlight can fall on them. Under these conditions rapid fading may set in.

Attention is drawn particularly to the fact that the most accurate colours will be obtained if the transparency is viewed in daylight, since the taking filters are prepared so as to correct for daylight viewing, but in order that all transparencies may be seen conveniently by artificial light, the Dufaycolor Viewers are provided with Half-watt to Daylight Compensating Filters, which should be used when viewing subjects by artificial light.

Similar filters can also be supplied separately in any convenient size which can be bound up with the transparency and, except in the case of lantern slides, a diffusing surface such as a piece of ground glass may also be employed. The compensating filter bound up with a ground glass diffuser is suitable for holding in contact with the transparency or for placing in a viewing tunnel or other viewing device.

Dufaycolor Slides for Lantern Projection

For the lantern slide worker Dufaycolor has the immense advantage that the danger of the slides being overheated in the lantern, and thus irretrievably damaged, can be minimised by obtaining duplicates of the selected subjects for projection, while the originals are safely stored away. If the originals are to be projected, they should be specially processed as described herewith.

When processing Dufaycolor transparencies for use as lantern slides, the time of first development should be increased slightly, for example, to four minutes at 65°F., as this will give a more transparent picture. Too light a transparency should not be aimed at, as this will lead to weak and unsaturated colours on the screen. It should be noted, however, that a transparency specially processed for projection will not prove suitable as an original from which copies are to be drawn.

Dufaycolor transparencies consist of non-inflammable film, and are therefore not dangerous on account of fire risk. If securely bound between glass, they are entirely satisfactory for projection, and will not buckle or melt. The two sheets of glass and the mask should be dried out. They should then be bound as tightly as possible, spotted in the usual way, and titled. The ordinary cut-out masks are entirely satisfactory, but the transparency should not be stuck to the mask in any way.

Varnishing the transparencies is not necessary and does not lengthen the life of the slide. In fact, if overheating occurs, the presence of a varnish layer may cause additional trouble.

PROJECTION

No special projector is required, and although Dufaycolor transparencies can never be as transparent as monochrome slides, any good quality lantern will prove satisfactory. Projectors employing a 500-watt lamp give excellent results, as will those using as illuminant the oxyhydrogen flame. As already mentioned, half-watt light is distinctly yellow as compared with daylight, and for this reason there is always a tendency for transparencies projected by such light to appear too yellow or too red. The error can be corrected by the use of a half-watt to daylight compensating filter placed (1) immediately in front of or behind the transparencies; (2) in front of the projection lens, or (3) as part of the lantern slide and bound up with it.

Of these alternatives (3) is preferable but rather expensive; (2) can be used successfully but softens the definition on the screen. Suggestion (1) is not satisfactory because the filter generally becomes far too hot and tends to increase the heating effect.

With powerful projectors, Dufaycolor lantern slides should not be projected for longer than 30 seconds at a time, as the combined action of heat and light may result in a fading of the colours.

Dufaycolor Transparencies in Show-cases

Highly effective displays and advertisements can be made with the aid of Dufaycolor transparencies exhibited in suitable show-cases. The method of illumination is of prime importance because, as previously mentioned, over heating must be eliminated if the transparencies are to have a long life. The lamps should be arranged in such a way that only indirect, reflected light reaches the transparencies. A sheet of ground glass should be used behind the transparency to ensure even illumination, but it is essential to leave a space of several inches between the transparency and the ground glass. A Half-watt to Daylight Compensating Filter should be inserted behind the transparency.

The temperature at the back of the transparency should not be more than 90°F.

SECTION V

COLOUR-SEPARATION NEGATIVES FROM DUFAYCOLOR TRANSPARENCIES

One of the greatest attributes of the Dufaycolor process is that it will yield first quality colour-separation negatives which are for all practical purposes as good as tri-colour negatives taken direct from the original. Since Dufaycolor only involves one exposure, and that very short, it means that it is possible to obtain three-colour negatives of moving objects, street scenes, and other subjects which cannot be recorded satisfactorily by three successive exposures.

The very fine grain of the Dufaycolor réseau, the absence of any black between the grains and of any possible clumping together of the different colours, combined with the carefully selected colour transmission of each of the colour elements of the réseau, account for the excellence of the colour-separation negatives obtained.

CONTACT NEGATIVES. A contact negative taken from a Dufaycolor transparency on a panchromatic plate shows only a very slight screen pattern due to the réseau because each of the colour elements records on the negative. When the exposure is made through a tri-colour filter placed over the light source the pattern is somewhat more obvious because only one of the three elements now records. In making contact negatives care is necessary to ensure even pressure all over, as otherwise slight lack of contact leads to distinct differences in the pattern and consequently in optical density. The very slight diffusion obtained by printing through the back of the film largely overcomes the pattern, and is recommended.

From these observations it will be noted that colour-separation negatives can be made using the ordinary Ilford Tri-colour Filters without any special precautions.

In the following tables the necessary exposure through the tri-colour red has been taken as unity, and filter factors are given for tri-colour green, tri-colour blue and gamma filters.

(1) For continuous tone negatives on Special Rapid Panchromatic Plates:—

Light Source	Tri-colour Red Filter	Tri-colour Green Filter	Tri-colour Blue Filter	Gamma Filter
Half-watt	1	4½	3½	3
Open Arc (white-flame carbons)	1	2½	½	1

(2) For screen negatives on Process Panchromatic Plates:—

Light Source	Tri-colour Red Filters	Tri-colour Green Filters	Tri-colour Blue Filters	Gamma Filters
Open Arc (white-flame carbons)	1	1½	3	1

For the fourth or grey printer negative an Ilford Gamma Filter may be used.

As is the case when making all tri-colour negatives, the blue filter gives a flat result, and it is essential to give about double the development time to this negative. However, with Dufaycolor, the flattening of the negative is greater than usual, and it is therefore recommended that the Blue Filter Negative (Yellow Printer) should be made on a non-colour sensitive plate in conjunction with an Ilford Q Filter (to eliminate the ultra-violet light) in place of a panchromatic plate and blue filter. Where the Ilford Special Rapid Panchromatic Plate is being employed, then the Ilford Ordinary is the most suitable plate for use in conjunction with it, but for screen negatives the Ilford Process Plate is necessary. When these plates are employed, the development time should be the same as for the Panchromatic Plates, but the exposure in the case of the Ilford Ordinary Plate will need to be about twice that for the Special Rapid Panchromatic Plate exposed through the red filter when using half-watt light, or one-third of the corresponding exposure when using open arc. In the case of screen negatives, the exposure with the Process plate through the Q filter will be the same as that for the Process Plate exposed through the red filter when using open arc light.

ENLARGED NEGATIVES. Enlarged colour-separation negatives can be made readily in the camera in the normal way. The réseau pattern can be almost completely eliminated, without seriously affecting the sharpness of the image, by placing the camera the very slightest degree out of focus.

SCREEN NEGATIVES. Where half-tone screen negatives are required for the various forms of photomechanical reproduction, either the direct or the indirect method may be employed. Naturally, the making of the colour-separation screen negatives directly in the camera from the Dufaycolor transparency is quicker and more economical than the indirect method of making colour-separation continuous tone negatives, followed by positives and subsequent screen negatives. However, both methods have their advantages.

Direct Screen Negatives can be made without any difficulties due to moiré being experienced provided that the degree of enlargement is not too great. With screens of 150 lines to the inch the negatives should not be made appreciably larger than the transparency, while for screens of 100 lines to the inch the subject may be enlarged to approximately twice the linear dimensions, with proportionate enlargement for screens of intermediate ruling.

The transparency, in its transparency holder, may be illuminated by the light of the arc lamps reflected from white paper. If short exposures are required it is preferable to use direct illumination through the transparency, but to ensure even lighting it is essential to take the precaution of placing an effective diffuser between the light and the transparency. For this diffuser a sheet of opal glass may be used, but a single sheet of ground glass is not sufficient; further, the diffuser should not be in contact with the transparency, but two to three inches behind it. Normal screen distance, stop and flash exposure should be employed, but it is impossible to give an accurate guide to exposure times. When using reflected light for illuminating the transparency, Ilford Rapid Process Panchromatic Plates should be employed, but with a powerful, direct light, use may be made of Ilford Thin Film Half-Tone Panchromatic Plates, which yield screen negatives of the highest possible quality.

The *indirect* method of working referred to above must be employed if the degree of enlargement required is greater than that recommended for the direct method. In practice, the limit of enlargement for fine screen work is likely to be approximately three times the linear measurements, because beyond this the loss of definition will become serious.

MONOCHROME NEGATIVES FROM DUFAYCOLOR TRANSPARENCIES

Although Dufaycolor Film is specially prepared to yield colour transparencies, there is no necessity to take the usual monochrome negatives as well as Dufaycolor if black and white prints are required. There is no difficulty in making a monochrome negative from a Dufaycolor transparency, either by contact or in the camera.

On account of the presence of the colour it is preferable to employ a panchromatic plate or film, the particular material chosen being governed mainly by the contrast required in the negative. Normally, we should recommend the Ilford Soft Gradation Panchromatic Plate or Ilford Panchromatic Film H. & D. 400, although for contact work the exposures must be controlled carefully.

The question of the filter to be employed is partly a matter of personal choice. Very pleasing results are obtained without the use of a filter at all, but the Ilford Gamma Filter gives a somewhat more natural rendering of the various colours if the exposure is made to daylight or to white flame arc light;

when half-watt illumination is used the Ilford H.W. Filter will be the most suitable. For portraiture and subjects where the contrast is comparatively low, the tri-colour green filter is preferable, as it gives the modelling which tends to be absent when the colour is eliminated. The disadvantage of this filter is that it only transmits one-third of the spectrum, and consequently the green elements of the réseau are the only ones to record adequately on the negative. Hence, there is an added granularity which must be removed by throwing the picture slightly out of focus or by printing through the celluloid side of the film in contact printing. The loss of definition is not serious, however, unless the subject has to be considerably enlarged.

SERVICE

Dufay-Chromex Limited have established a Dufaycolor Processing Station with a trained staff and all equipment for the processing of any Dufaycolor material and have appointed Dufaycolor Approved Processing Houses in several important parts of the country. Users of Dufaycolor Roll Films, Films for Leica, Contax and similar miniature cameras and Ciné Films are requested to return their exposed material to Dufay-Chromex Limited through a recognised photographic dealer. The color positives will be sent in the course of a few days.

Users of other Dufaycolor materials will find processing instructions enclosed in each packet should they wish to develop their own exposures, but if they prefer, all such work will be undertaken for them.

When exposures which are forwarded for processing are intended for use as *lantern slides*, this fact should be plainly indicated, when special treatment will be given to ensure that the transparencies are suitable for projection.

In addition *duplicate transparencies* can be made, using a special patented process which enables excellent results to be obtained, although it had always been considered in the past that copying colour transparencies was not possible without serious loss of colour and brilliance. Such duplicates are the same size as the original. Copies can be made only from original Dufaycolor transparencies and not from previously prepared copies; hence the originals should always be sent when further copies are required.

Black and white negatives, either contact or enlargement, can be supplied readily to order, so that if bromide prints are required it is not necessary to take a normal monochrome negative as well as the colour transparency. The making of bromide prints is not undertaken by Dufay-Chromex Limited, as this is part of the business of the trade printer.

Any unusual processing requirements of customers will be considered and the full resources of the Dufaycolor Technical Staff are at the service of Dufaycolor customers. If information not given in this book is required, please address enquiries to Dufay-Chromex Limited, 14-16 Cockspur Street, London, W.1.

How to order Dufaycolor Film

(1) Please specify accurately what is required and include the word "Dufaycolor" in your order. Do not forget to state size.

(2) If Taking Filter is required, please refer to page 10 and order your filter by the Code Number.

(3) Please state size of filter required.

(4) If transparencies are to be viewed by half-watt light, a Dufaycolor Compensating Filter will be required. Such a filter is supplied with the Dufaycolor Viewers, but for larger sizes the Compensating Filters can be purchased separately.

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